

# **WRIA 12 Watershed Management Plan Technical Assessment Scope of Work**

(Final version August 10, 2001)

## **Task 1: Information tasks**

Objective: Identify known data sources, standardize data handling protocols, and establish planning area.

### **Subtask 1.1: Add to and refine County data/resources list**

Activities: The Planning Unit, Lead Agency and the Consultant have initially gathered substantial data. Working with the Lead Agency, finalize the list of data/resources to be used for the project. (Other data or resources may become available at a later date.)

### **Subtask 1.2: Define data format & handling procedures, data storage, and compatibility with Agencies.**

Activities: To the degree defined by the Planning Unit, establish the protocols and formats for handling and storage of data and project website in a meeting with the Planning Unit. Work to meet the needs of the various public agencies that will make use of the data sets and provide compatibility with their existing data handling routines.

### **Subtask 1.3: Generate basin base map**

Activities: Using the existing County GIS system maps, prepare a suitable base map of the WRIA in order to facilitate the later plotting of data sets and sub-basin definitions and to coordinate data handling efforts by the Consultant.

### **Subtask 1.4: Collect and refine reach & subbasin definitions from County**

Activities: Combine existing definitions of stream reaches and subbasins within the WRIA and refine these to form the project subbasin and reach definitions. These definitions will allow data entry in the GIS tool (Subtask 3.1b) to be identified by subbasin and will form the basis for Subtask 3.3.

Deliverables: The following products will be provided to the Planning Unit following Task 1:

- List of known data sources
- Electronic Planning Unit GIS base map with subbasins in ArcInfo 3.x to be compatible with the Pierce County CountyView system.
- Data management protocols

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Each Planning Unit member identify data resources in their possession
- Attend and participate in data management protocol meeting
- GIS point of contact for Pierce County CountyView system and/or products.

## **Task 2: Create Conceptual model of basin**

Objective: Prepare a conceptual model of the Clover-Chambers Creek basin in order to document physical processes, provide context for subbasin interactions, and facilitate Planning Unit discussions and the ultimate Watershed Plan.

### **Subtask 2.1: Develop Conceptual Flow Model for whole WRIA**

Activities: To estimate the water budget of the WRIA properly, create a conceptual flow model of the basin. This will describe the water flow patterns (both surface and ground water hydraulic continuity) in, through, and out of the basin. Following this subtask, the model will describe only the general water movement and interaction between physical processes to be identified in this project. The water quantity will be determined in later tasks.

#### **Subtask 2.1a: Describe basin recharge mechanisms (inflow)**

From existing data and based on established theory, define the input mechanisms for water flow in the basin including, but not limited to, the following:

- Precipitation
- Recharge locations based on surface geology
- Missing confining layers
- Interbasin transfer
- Leakage

#### **Subtask 2.1b: Describe basin discharge mechanisms (outflow)**

Describe the types and general locations of the major discharge features of the surface and groundwater systems. Reaches of streams that clearly gain water will be identified and correlated with the aquifer maps to determine where ground water is discharged to the streams of the basin. Groundwater flow systems will be evaluated to identify where there is implication of discharges to Puget Sound or through basin boundaries. At a minimum, the task will address the following:

- Spring outflows
- Saltwater discharge
- Water withdrawals/diversions
- Evapotranspiration
- Interbasin transfer
- Leakage

### **Subtask 2.2: Prepare Sub-basin Definitions using conceptual flow model**

Activities: Prepare subbasin model descriptions using the conceptual model.

Deliverables: The following products will be provided to the Planning Unit following Task 2:

- A conceptual model for the Clover-Chambers Creek Basin and subbasins identifying physical processes and water flows (inflows/outflows) to be identified in this project. The model will serve as the basis for completing the assessment and as a future planning tool.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Assist in identification of appropriate inflows and outflows.
- Approve the conceptual model generated needed to complete the basin assessment.

## **Task 3: Information search & acquisition**

Objective: Review and assemble data into the conceptual model to identify water balance data gaps.

### **Subtask 3.1: Prepare Bibliography for Data Model**

#### **Subtask 3.1a: Prioritize Model Data**

Activities: Evaluate collected reports or data sets for use in the conceptual model. Review the available data and sort based on age, consistency and applicability. Where applicability is unclear, the Planning Unit will make final determination for inclusion. Each report synopsis will include a list of assumptions used and the data objectives of that report.

#### **Subtask 3.1b: Create GIS entry & data summary**

Activities: Prepare a searchable database in either Excel or Access, and develop a synopsis of the document contents. This will be included in the database and presented in a binder for easy reference. Prepare a summary of GIS layer(s) available on the County's ArcInfo system. Create user queries for watershed quantity, quality, habitat, and groundwater conditions for specific areas within the WRIA. The GIS system can be linked to existing databases, new databases such as the summary information set referenced above, or to hot links to other websites such as the USGS for determining real-time flow conditions on Leach, Flett, Chambers, or Clover Creeks (dependent on gage capabilities).

### **Subtask 3.2: Determine data gaps**

#### **Subtask 3.2a: Location & nature of lacking data**

After the completion of Sub-task 2.2, identify data gaps and prioritize in collaboration with the Planning Unit for completion of the Technical Assessment.

#### **Subtask 3.2b: Develop Action Plan for Data Gaps**

Activities: Present the prioritized list to the Planning Unit and collaborate on the appropriate approach for collecting new information. Once the Planning Unit has agreed to the objectives for new data collection, a scope of work will be prepared. Upon approval of the Planning Unit, begin generating identified data sets or direct the collection of data by other agents (e.g. TPCHD staff, water purveyor staff, or through a cooperative work agreement with a State or Federal Agency). As the new data is gathered, integrate the results into the conceptual model as the project timing permits.

### **Subtask 3.3: GIS product generation**

Activities: Coordinate with County and other recipients of web-based products for transfer of information and facilitate communications. The Consultant proposes the development of special tools to facilitate the review of project-related documents and access to project related data sources. These tools, based on modified versions of existing tools, will be accessed through a GIS interface.

The tools proposed consist of the following:

1. A Project Collaboration Website that permits instant access of all project participants to all project data and reports.
2. Document management software that accepts metadata geocoding to link to the GIS for access, and document summaries. Copies of this application will reside in each Consultant office where information is to be added. At specified intervals, copies of the individual databases will be uploaded to the Project Collaboration Website for

replication and re-distribution. All participants will thus have access to the latest version of the database.

3. An ArcView Avenue Code application that allows the document management software to be queried based on geographical entities, and allows links to other on-line documents and data sources (for example, the USGS real time and historical flow gauge information).

GIS coverages for use in the application will be prepared by PC for use with the system. The project Consultant will discuss the requirements of the system and any coverages that will need to be developed. Shape files containing the GIS data will be uploaded to the Project Collaboration Website to be used in the application.

Deliverables: The following products will be provided to the Planning Unit following Task 3:

- A data synopsis summarizing the prioritized data used in the conceptual model
- The conceptual basin model for the Clover-Chambers Creek Basin and subbasins with prioritized data compiled.
- Prioritized list of data gaps needed to complete the basin model
- Scope of work for developing the missing data for the basin model.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Attend and participate in data collaboration and ArcView meetings.
- Approve the scope of work for preparation of missing data
- Preparation of GIS coverages from the Pierce County database and GIS support in building the web interface.

## **Task 4: Describe physical setting of WRIA 12**

Activities: Prepare a basin-wide description of surface geology, topography, surface water features, aquifer and confining layer definitions (hydrostratigraphy), and other pertinent physical components of the WRIA. This will include the review and update the previous definitions of the boundary conditions for the major water features of the WRIA 12 area, including each of the identified aquifer systems. We will generate appropriate maps of the lateral extent of the aquifers and contour maps showing the potentiometric surface that reflects the dynamics of the system.

### **Subtask 4.1: Surface geology**

Using the available data, generate a map of the surface geology conditions of the basin.

### **Subtask 4.2: Topography & water features**

Collect the County GIS data for topography and map this and surface water features on a single map of the WRIA.

### **Subtask 4.3: Aquifer & confining layers**

Based on previous work, generate top elevation and thickness maps for each of the four major aquifer systems in the basin plus at least two of the intervening confining layers (Layers B and D). These maps will define the lateral boundaries for each aquifer and allow projection of depths and thickness of each aquifer or confining layer onto the subbasin models created in Subtask 2.2. This will help to describe the routing of water through the various subsurface layers. Where data is available, address the hydraulic gradient of each aquifer as it relates to surface water issues and to determination of flow through the system.

#### **Subtask 4.4: Land use**

In order to evaluate the effects of differing land use on the movement of water within the basin, import the County land-use map into the project GIS product. Land use can then be broken down by sub-basin to address site specific issues.

Deliverables: The following products will be provided to the Planning Unit following Task 4:

- Surface geology map for Clover-Chambers Creek basin (1 map)
- Topography and water feature map (1 map)
- Aquifer and confining layer maps for subbasins (up to 16 maps)
- Land Use maps (up to 4 maps)

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Provide input to the development of the physical setting as appropriate

### **Task 5: Estimate Sub-basin Water Supply**

Objective: Together with Tasks 6, 7 and 8, estimate the total available supply of water for the WRIA 12 area by subbasin.

Activities: Using available data and conceptual basin model, estimate the seasonally available water supply and storage volume for each aquifer. Apply the recharge and discharge estimations for the basin and determine the portion of the storage and recharge available to support water needs in the basin without diminishing key discharges (such as deep aquifer recharge, or stream baseflow). Surface water interactions or effects will be included to the limit of the available data. Finally, based on the results of Task 2 and existing statutes, provide a clear differentiation between various types of stream flow definitions (baseflow, instream flow, minimum flow, etc.) such that a common language is used throughout the assessment.

Anticipated data sources to be used for this task include rain gages in the GIS database, isopleth maps and historical rainfall and stream gage records. This data will be analyzed to determine whether statistically significant spatial precipitation and water supply variations occur within the watershed and identify surface aquifer recharge patterns. (This data may be used in other investigations for contaminant transport modeling within the basin and generate simulated hydrographs.)

Once workable estimations of surface or groundwater flow volumes and timing are completed, determine the total water available during several defined conditions:

- low water/"drought" conditions,
- average "dry" year,
- average "wet" year, and
- high water/flooding conditions.

The estimations of water throughflow for these different conditions will contrast the changes to be expected over time as weather conditions fluctuate from year-to-year.

#### **Subtask 5.1: Describe basin streamflows**

Collect and place the existing data sets into a GIS database allowing for analysis of historical trends in runoff volumes and peaks and comparisons with historical rainfall

patterns. Use seasonal patterns and system responses to extreme events to identify management issues. Define the general flows and exceedence analyses characterize the streamflows of the WRIA. Include a description of the spatial and temporal water quantity characteristics of the basin and provide an understanding of the influence of basin characteristics on water quantity. Present water quantity data from sub-basins and discuss in terms of the specific characteristics of the associated subbasin or catchment area. Similar basin analyses should be applied to sub-basins requiring additional investigation.

Collect and assess data from the following sources:

- USGS – numerous gages throughout system including Clover Creek near Tillicum (1950-70) and others on Spanaway and Morey Creeks that are no longer used but have valuable data sets. Current gages including Leach Creek at 40th, Leach Creek at Bridgeport, Chambers Creek below Leach Creek, Flett Creek, Chambers Creek near Steilacoom, and Clover Creek near Parkland (1960-75, 95-00)
- Pierce County Water Programs – Clover Creek Drainage Basin Plan, North Fork Clover Creek Study (USGS), North Fork Clover Creek Floodplain Study, flow records for withdrawals at Chambers Lake for mining operations, and rainfall records
- City of Tacoma – Leach Creek Hydraulic Study, Leach Creek Flow Augmentation Study, Leach Creek Stormwater Pumping Station records, Flett Creek Stormwater Pumping Station records, Puget Creek flow data, misc. flow records for drainages, and rainfall records
- Department of Ecology – water level data for Steilacoom Lake, Gravelly Lake, American Lake, Lake Louise, and Spanaway Lake. Also survey data of water withdrawals from Clover and Morey Creeks.
- Environmental Protection Agency – Steilacoom Lake, American Lake, STORET database
- WDF&W- Flow records for Sequelichew (fish hatchery), Chambers Bay (fish ladder and hatchery), Chambers Lake and Creek, Flett, Leach, and Clover Creeks (fish ladders)
- Tacoma-Pierce County Health Department (compiled data sets)
- U.S. Army Corps of Engineers – 1974 backwater study of Clover Creek, National Flood Insurance Program data
- Department of Defense – Surface water data from Ft. Lewis and McChord, particularly the Sequelichew/American Lake works.
- NOAA – rainfall data for rain gages within Pierce County
- Pierce County Stream Team
- Additional sources, such as public schools, universities and community groups .

The database will include the statistical analyses including daily and monthly exceedences, peak annual flows, two, ten, 50, and 100-year flow rates, and also lowflow statistics, if developed.

The existing data will be evaluated to determine if regulatory low flow values have been assigned for the various sub-basins. If not, provide an evaluation of whether such a determination is possible using available data and accepted standards (Department of Ecology, WSDF&W, or USGS). If low flow limits have been established, as with Leach Creek, an assessment will be made to determine if suitable water quantities appear to

be available for potable groundwater use by evaluating the frequency of excursions below the low flow limits. This assessment will allow for analysis but is not intended to establish in-stream flow limits.

### **Subtask 5.2: Describe ground water/surface water continuity for key locations**

Where information is available, the connection between the shallow aquifers can be established by comparing the elevations of aquifers to the elevations of stream channels and then comparing the water table or potentiometric surface of the aquifer to the elevation of the stream through that reach. Identify those areas where the streams are likely to be gaining or losing water. Corroborate this characterization through comparison of time-synchronous streamflow records during low precipitation periods.

The use of the streamflow records at this stage will be hampered by the fact that the records are not thorough enough in many reaches to allow for rigorous analysis of gain and loss. As the technical assessment is implemented, it is likely that the direct measurements of the gain or loss from stream reaches will become a more applicable tool. It will be applied in the assessment to the degree possible.

Two key indicators will be addressed during the data search and review: the records of lake-level changes and water level changes in wells in proximity to surface water. Where such data is available, correlate it to seasonal patterns in streams and well records to identify patterns that reflect the exchanges between ground and surface waters.

### **Subtask 5.3: Describe existing water allocations**

Activities: Work with Planning Unit designated staff to describe the existing water right allocations and actual water use characteristics in WRIA 12. Collect water rights data from state records and compare them with existing evaluations such as compilations of water purveyor water rights. State Department of Health records and comprehensive plans will also provide insights into water use. (This process is not an adjudication of the basin's water rights; the validity of individual water rights cannot be addressed.) After collection of data but before evaluation, meet with the Planning Unit to define a minimum threshold size of water right above which a right will be checked against available use records to verify use of the right. Evaluate and reduce the water rights records and claims to statistical statements that will allow estimation of water use in areas where data is not available. Address individual water use using aerial photos or space images to identify water use outside of service areas. Identify the rights by type, location, priority, and amount (divided into primary and supplemental categories where appropriate). For those rights above the stated threshold, provide a comparison of actual versus stated water rights use. To the degree practical, present the data in a GIS database format to allow staff to maintain a current description as the watershed plan progresses.

Though it is impossible to ground-truth each water right and claim, it is prudent to attempt to characterize the major rights and claims and to adjust the water right allocation statistics accordingly before incorporating them into the water budget considerations. Additionally, it will be necessary to address the issue of illegal water use to whatever degree possible. Working with the TPCHD staff, analyze the records and statistics to define the basin management implications. The results of this process will then be incorporated into the remainder of the Technical Assessment.

#### **Subtask 5.4: Identify historic water level trends**

Activities: Collect the available information of historical significance on water level trends and compare the noted trends to the conceptualization of the basin flow patterns. The data will come from water purveyors, surfacewater monitoring sites, water quality monitoring sites with coincident water level data, and other similar sources. Present the trends as representative hydrographs and in statistical analyses to identify regionally significant and temporally significant phenomena. Identify any problem areas for long-term water supply issues.

Deliverables: The Consultant will provide the following to the Planning Unit:

- Summary of the streamflow conditions of the basin.
- Summary of ground water/surface water continuity conditions.
- Summary database of existing water rights and claims.
- Summary of historic water level trends, where significant.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Maintain awareness of task process and provide requested data sets
- Assist in and guide the evaluation of water rights and claims within the basin.
- Review and comment on the results of this Task

### **Task 6: Estimate existing quantity needs for People**

Objective: Together with Tasks 5, 7, and 8, estimate the total existing anthropogenic water demand for the WRIA 12 area by subbasin.

Activities: Relying upon the data already prepared in the Pierce County Coordinated Water Supply Plan, estimate water quantity demands of current population including domestic water, irrigation, and industrial uses. Where appropriate, the estimates should distinguish between the use of population and employment forecasts or water system demand estimates as a basis for needed quantity. Provide summaries of each estimated type of use with appropriate notation of any assumptions and the source of data for those assumptions. To ensure greatest accuracy, an economist will review the estimations and provide input where appropriate.

#### **Subtask 6.1: Estimate domestic water quantity needs**

Activities: Using land-use data, water system plans, Class A water system well database, and historical water consumption records, develop water consumption patterns for each subbasin. Differentiate uses based on location within or outside of the Urban Growth Boundary. Develop unit consumption estimates for up to six different categories to apply to areas without historical data. Using sewer service areas, estimate municipal return flows from septic tanks in tabular and graphical form by use, by subbasin, and type using the following information sources:

- Federal, County and City planning population and employment estimates and forecasts
- Current population records
- Federal, City or Municipality, and Water purveyor use records
- Unregulated withdrawals

#### **Subtask 6.2: Estimate Irrigation Demands**

Activities: Using land-use maps and aerial photography estimate irrigation demands in each subbasin. Where irrigation demands exist, attempt to characterize stream conditions. Estimate the quantity and type of irrigation, quantity of return flow (or

recharge), and historic seasonal and daily use patterns. Where available, data on the existing irrigation needs verses water rights (or entitlements) will also be included. Compare summer versus winter water use by non-irrigators to identify landscape irrigation quantities.

### **Subtask 6.3: Estimate Exempt Well Demands**

Activities: Estimate the potable water demand based on well data, existing County evaluations, and land use data/aerial photography. Estimate the number and distribution of domestic exempt wells in the WRIA, and estimate consumption using statistical methods. Where historic records of use are available, evaluate historical seasonal water consumption trends.

### **Subtask 6.4: Estimate Major Industrial Demands**

Similar to the evaluation for municipal/domestic water needs, estimate the major industrial water rights and water uses in the basin and characterize them by type, location, amount, and historic use. Include water use for power generation facilities.

Deliverables: The following products will be provided to the Planning Unit following Task 6:

- Distribution maps and tabulated data (including a list of the assumptions made) for each subbasin.
- Comprehensive summary of present seasonal municipal and domestic water consumption by subbasin.
- Comprehensive summary of present seasonal irrigation consumption by subbasin.
- Comprehensive summary of present industrial water consumption by subbasin.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Provide current water system plans, land use plans, metering and billing data, and well performance data (domestic, industrial, agricultural, non-potable)
- Provide point-of-contact references for data

## **Task 7: Estimate Water Quantity and Fish Habitat Relationships**

Objective: Define current and projected habitat limitations by subbasin based on available data.

Activities: Compile and organize existing data available regarding aquatic (fish) habitat in WRIA 12 by subbasin.

It is important to note that the efforts under this work item are descriptive in nature and are not intended to reflect additional research, field inventory, or detailed field assessments. Identify, summarize and organize existing and available information (gathered in a cooperative effort with the Tacoma-Pierce County Health Department and members of the Planning Unit). Data collection will include, but is not limited to: reports, programs, field data, management plans, watershed evaluations, stream surveys, wetland delineations, air photos and other maps, as well as any other relevant source of biological information for the watershed subbasins. With the assistance of the Planning Unit, coordinate with existing projects to avoid duplication of effort and perhaps offer opportunities for data exchanges. With knowledge of the nature of the on-going projects as a guide, proceed to describe the following habitat issues.

### **Subtask 7.1: Describe fish distribution and listings**

Solicit fish distribution data from WDFW, Tribes, Fort Lewis, McChord AFB, and other agencies as well as colleges and other schools through written requests and direct

contact (visits and telephone calls). The data will be compared to the species listed under the Endangered Species Act to determine future planning needs and management. Data sources should include but not be limited to:

- PHS Maps
- ESA Lists from NMFS and USFWS
- Past EIS's and land use permit documents
- USFWS special studies
- WDFW/Tribal spawner counts & records
- Community Groups

#### **Subtask 7.2: Describe water quality issues for fish**

Temperature, dissolved Oxygen, Biological Oxygen Demand, pH, turbidity, metals, pesticides, etc. are issues relevant to fish survival. Collect and summarize the published tolerance range of these parameters for target species then compare to available water quality data for the various reaches and stream segments. Identify areas where data are lacking and note for future investigation. Also note locations within the drainage where existing water quality poses a threat to fish survival and those areas where water quality appears to be within tolerance ranges. Initial data sources we anticipate for this effort are:

- review published information- RCW/WAC, physiology texts, etc.
- Chambers Creek hatchery water quality and water quantity records over time.
- Lake water quality records (if available)
- Land Use monitoring requirements (i.e. golf courses, gravel mines, etc. must monitor their effluent or stormwater).
- Community Groups

#### **Subtask 7.3: Describe sedimentation and substrate quality**

Gather existing habitat suitability curves for salmonids with respect to substrate habitat conditions and any stream habitat assessments that may have been completed by universities, the state or Tribes. (If no data are available, seek direction from the Planning Unit on whether to omit this task or define the necessary data collection.) Compare this data to the existing conditions as reported in available documents. Assess scouring, bedload movement, and other flow-related habitat conditions listed in the available data to determine problem areas and zones of quality habitat. Where appropriate, estimate gravel imbeddedness and grain size.

#### **Subtask 7.4: Describe riparian habitat and side channels**

Riparian habitat is an important aspect to stream health and long-term functions of fish habitat. However, little side channel habitat appears to exist within the drainage. Review available information (e.g. new high-resolution satellite photographs plus County orthophoto resources) to produce an overlay of the basin that illustrates the riparian conditions within each reach segment. Riparian habitat will be described in terms of estimated percent cover by vegetative strata (trees, shrubs, herbs) and by estimated riparian area width surrounding aquatic habitats. Shade estimates will also be attempted in terms of percent shade over channel width. Orthophoto and other photographic record interpretation will be the primary method of this investigation. Use historical information to compare the alterations to the basin that have occurred over time and to indicate areas that may be available for restoration and future enhancement.

### **Subtask 7.5: Describe food web for basin fisheries**

Assess the overall health of the stream system based on which benthic macroinvertebrates are or are not present. (Several species are intolerant of pollutant loading whereas others are used as indicators of pollution and degraded conditions. Similarly, some are tolerant of temperature fluctuations and others are not.) If the macroinvertebrates species assemblages have been recently monitored, use this data to identify basin health indicators. Use published ecological webs for riverine systems. Solicit information from the Pierce County and local jurisdiction Stream Teams, community groups involved with stream stewardship, and appropriate agency personnel concerning the available data for food sources. Documentation of food web-based activities within the watershed will be sought from these entities. Documentation may include, but not be limited to:

- Salmon carcass distributions
- Aquatic invertebrate sampling records for various streams in WRIA 12
  - Educational entities (Colleges and other schools)
  - Community groups
  - McChord AFB, Fort Lewis, other federal agencies
  - State Agencies
  - Local jurisdictions

### **Subtask 7.6: Inventory barriers to fish passage**

Identify barriers to fish passage using the WDF&W database, the Pierce County database, Conservation District documents, state and Tribal information (plus additional data as available). Relay this information to the Planning Unit Committee along with identified remedial measures, either structural or flow related (such as augmentation). If additional obstructions or flow related problems are identified outside of the existing databases, this information will be detailed in a technical memorandum and delivered to the Planning Unit as well as the governing jurisdiction or entity.

### **Subtask 7.7: Describe TMDL/habitat relationships**

Within WRIA 12, eleven waterbodies have been placed on the EPA's 303(d) violations list for excursions from applicable water quality standards. The violations range from low dissolved oxygen to fecal contamination (the most number of hits). The Department of Ecology will be required to develop TMDLs for all water bodies within the state on the 303(d) list within ten years after the new TMDL rules become effective in 2002. Since there are over 640 currently on the list, Ecology will not have much time to devote to each waterbody. This should be reflected in any decision matrix devoted to assessing where to focus limited resources.

TMDL limits have been established for Steilacoom Lake (phosphorus). The City of Lakewood and Pierce County Water Programs are currently challenging these limits. Additionally, Chambers Creek has a TMDL for copper based on application of aquatic herbicides to the lake by the Lake Steilacoom Improvement Club to reduce summertime algal blooms. Compliance data, monitoring records, descriptions and development reports will be collected from the appropriate agencies, summarized and included in the GIS database if sampling data availability allows. Compare to published acute and chronic pollutant concentrations for fish and other relevant aquatic species.

Include waterbodies on the 303(d) list on a GIS map along with links to the water quality data or a descriptor identifying the location of the data if not already in an electronic format.

**Subtask 7.8: Collect historic/existing stream flow records for WRIA 12 and Identify biologically significant flow changes**

Scientifically characterize general habitat requirements for aquatic resources with respect to flow based on existing information. Relying upon data collected and analyzed in Subtask 5.1, identify problem areas within each sub-basin where low- or high-flow problems exist for salmonids. Areas identified with a high potential for fish and redd stranding should be included in this evaluation. Assess available historical data (air photos, flow records, regional stormwater and sewer system records, hatchery records at Chambers Creek, etc.) for comparison to existing conditions. Utilizing data from the Pierce County Regional Endangered Species Act Initial Response Plan, the state's limiting factors assessment, and the Mobrand Biometrics EDT results, determine areas where stranding may occur.

**Subtask 7.9: Identify habitat restoration projects and programs**

The results of the efforts associated with Task 3 will yield maps of the fisheries-related issues and concerns. The basic fish distribution maps will show where the various species currently reside and areas that may become available for population growth with better management and enhancement. This task will require some coordination between the Planning Unit, the Salmon Recovery Funding Board and Community Groups in order to obtain a current list of protection and restoration projects within WRIA 12. Areas observed and estimated to have suitable habitat or areas with degraded habitat will be noted for input into the overall basin management program. Refugia (spawning and rearing areas that are currently in good shape) will be recommended for preservation. Zones with poor riparian habitat conditions will be targeted for restoration and enhancement. Channel conditions that are degraded and within close proximity to refugia areas should be considered for reconstruction and improvement. Provide inventory maps to the various agencies and community groups for comparison to the currently planned habitat restoration and enhancement projects within the basin.

Deliverables: The following products will be provided to the Planning Unit following Task 7 (subject to the limitations stated in the Task description above):

- Fish Distribution Map by Species and ESA listing
- Summary of Water Quality Issues Related to Fish
- Summary of Sedimentation Concerns and Substrate Quality by Sub-Basin
- Summary of Riparian Habitat and Side Channels by Sub-Basin
- Summary of Food Web Condition by Sub-Basin
- Summary of Fish Passage Barriers (with Map) by Sub-Basin
- Summary of TMDL/Habitat Relationships
- Summary of historic/existing Biologically Significant Flow Changes by Sub-Basin
- Bibliographic Reference List
- Listing of Current and Potential Habitat Restoration Projects and Programs by Sub-Basin (with map)
- Presentation of Task 7 results at Planning Unit Meetings or Workshops

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Assist with data collection across all elements of this Task
- Define species presence and future species habitat goals.
- Review and comment on the results of this Task

## **Task 8: Estimate quantity needs to meet Water Quality**

Objective: Together with Tasks 5, 6, and 7, estimate the total water quality demand for the WRIA 12 area by subbasin.

Activities: Determine water demands for people, biological, and water quality needs.

### **Subtask 8.1: Describe surface water quality**

The Department of Ecology, EPA, NAWQA, City of Tacoma, Pierce County, TPCHD and others have collected surface water quality data within the Chambers-Clover Creek Watershed since the late 1970's for various reasons. Collect and compile these data sets into a GIS data set and describe historical and spatial trends, if any, on water quality throughout the watershed.

When evaluating the existing data, assess the protocols used to obtain the data and the laboratory procedures used. Evaluate the data for relevancy to the end-goals of the management plan and prioritize for inclusion based on available resources and time.

One of the more detailed investigations on water quality in the watershed was conducted by the USGS in 1991-92 on the surface water quality of the Clover Creek Basin, Report 95-4181 (1996), including sampling at 15 data sites over a 16-month period. This report should allow for a quick summary the health of the Clover Creek basin and identify action items for tracking changes in the water quality since the 1991-2 data was obtained.

In the 1991-2 study, the USGS determined that four characteristics have specific, dominant effects on the water quality within the basin: permeability of surficial geologic materials, land use, sewage and stormwater disposal methods, and the presence of lakes within subbasins. Based on this assessment, quantify to the degree possible, the anticipated changes on water quality within the watershed due to development activities, extensions of sewer lines, and changes to stormwater disposal and treatment practices that have occurred since the original study. Evaluate any additional investigations that have been conducted since the study in order to improve the understanding of the effects of groundwater on surface-water quality within the Clover Creek drainage.

Investigate the following sources for historical data:

- City of Tacoma data for subbasins that flow through Flett and Leach Creeks to Chambers Bay
- Tacoma and ASARCO data on smaller drainages which discharge to Commencement Bay

Review the data to determine if a causal linkage can be made between water quality and declines in fish and wildlife habitat. (Based on work conducted within the watershed to date and nationally, it is anticipated that a definitive link cannot be drawn, with the exception of exceedances due to deliberate spills of contaminants into a stream system, which may not have been recorded.)

### **Subtask 8.2: Describe groundwater quality**

In any groundwater investigation of the region, there are two basic water quality considerations: adverse background water quality (regional) and the downstream

proximity from potential sites of pollution (local). To address these issues, compare data generated on a site-specific basis with regional water quality research to describe the basin-wide groundwater quality conditions. Since much of the groundwater quality information will be available from records of public supply wells, this data will likely be in formats sufficient for inclusion into the GIS database. Data from site-specific water quality studies (or remediation work) can be added where appropriate.

### **Subtask 8.3: Assess land use interactions**

Recent work by Pierce County Water Programs in developing the Chambers-Clover Watershed Non-point Characterization and Action Plan (1997) incorporates a significant amount of information relevant to identifying past and present land uses, best management practices, and other activities/issues identified by the Planning Unit. Characterize the entire water resource inventory area using this existing information and information from the City of Tacoma. Provide a discussion on historic methods used for urban stormwater control, on-site sewage systems and newer sanitary sewer systems, and impacts on the drainage system over time due to these activities. Include a discussion on the future direction including any pilot studies being conducted within the WRIA.

Discuss the potential with Pierce County Environmental Services to determine what studies, if any, have been conducted to prove or disprove a commonly held conception that the sewer trenches are draining the upper aquifer. Provide a generalized discussion of the issue.

### **Subtask 8.4: Identify water quality restoration activities**

Research what water quality treatment activities are underway or proposed within the WRIA. This will be accomplished by contacting the various jurisdictions, state agencies, Puyallup Tribe, and the Conservation District, with activities or jurisdiction in the WRIA. Private sector agencies/groups should also be contacted to determine their planned activities or knowledge of problem areas and any suggested solutions. Compile a list of current and planned structural and non-structural activities devoted to improving the water quality within the WRIA.

### **Subtask 8.5: Describe impacts of fresh water on marine water quality**

For the Chambers/Clover Creek drainage, fresh water and marine water quality are clearly interrelated. At the mouth of Chambers Creek, an important estuary exists and beyond that, an expansive eelgrass bed lies offshore of the railroad bridge. This eelgrass bed is critical habitat to anadromous salmonids and provides spawning habitat for baitfish. The lakes within the system can act as heat sinks or sources and may affect the temperature of the estuary as flow regimes become diminished or accelerated. Pollutants such as metals, nutrients and chemicals often react differently in marine environment as compared to fresh water.

### **Subtask 8.6: Describe sediment quality**

Using National Resource Conservation Service and Conservation District data, characterize the erosion potential and stability of the sediments and soils within the Clover Chambers Creek subbasins. In addition, using other regional water quality reports identify potential nutrient bearing sediments and soil layers (phosphorus emphasis) which may introduce nutrients from the aquifer to the watershed through groundwater/surface water interface.

### **Subtask 8.7: Define necessary water quantities for quality**

Using the above data, estimate the required water quantity to achieve water quality standards in each subbasin. The analysis will evaluate the effects of dilution and velocity as the primary mechanisms considering ambient water quality.

Deliverables: The following products will be provided to the Planning Unit following Task 8:

- Summary of surface water quality of basin (by subbasin where possible)
- Summary of groundwater quality
- Summary of land-use interactions within basin
- List of water quality restoration activities and summary of status
- Summary of impacts to marine environments from fresh water
- Summary of sediment quality
- Tabulation of water quantities necessary to meet water quality issues for each subbasin (and total required for whole basin).
- Estimate of total water supply available to basin

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Assist with data collection & coordination with outside restoration activities
- Review and comment on the results of this Task

## **Task 9: Develop generalized Water Budget for WRIA 12**

Objective: Develop a water budget for current conditions in WRIA 12 including a balance of inflows versus outflows and identification of surpluses and/or deficits. Identify potential causes for noted existing water quantity problems.

Activities: Combine the information collected in Tasks 4 through 8 into the basin model and prepare water budget summaries for each subbasin. Identify potential mechanisms and causes for local deficits based on the available data and basin model results. Identify and estimate the potential available/developable water supplies for WRIA 12 including, conjunctive use, reclamation, and aquifer storage and recovery (ASR), to satisfy local deficits. A comprehensive evaluation of water availability within the context of these various water management scenarios will be developed.

Deliverables: The following products will be provided to the Planning Unit following Task 9:

- Water budget summaries for each subbasin
- Basin Model graphics summarizing the water budget for each subbasin and the overall WRIA 12 area.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Review, comment and approve basin model summaries.

## **Task 10: Project Future Annual Water Resource Needs**

Objective: In accordance with RCW and appropriate state guidelines, prepare five alternative water demand scenarios for WRIA 12 area by subbasin for comparison against available and developable supplies through the year 2050 or “maximum build-out”.

Activities: Having established the basin model for present conditions, with the assistance of the Planning Unit, the Consultant will prepare up to five alternative water demand scenarios for

future conditions. Scenarios will be used to test the sensitivity of the water balance against multiple factors. Factors may include land use, population and commercial development rates, environmental and habitat preservation requirements, recreation, etc. List assumptions included in the projections and provide a confidence ranking for each scenario.

#### **Subtask 10.1: Demand forecast for people**

Activities: Using County planning projections and approved Water System Plans, prepare water demand forecasts applying variable growth rates, water conservation practices, land use development, etc. for a 25-year planning horizon (planning years 2005, 2010, 2015, 2020, and 2050 or “maximum build-out”.) Conduct a workshop with the Planning Unit to discuss consideration of alternative demand scenarios.

#### **Subtask 10.2: Future water needed for fish habitat**

Activities: Using the previously summarized habitat assessments, prepare demand estimates for the planning area to describe the range of potential adjustment necessary to preserve, restore, maintain habitat for identified species. The goal of this activity is to identify the extent of water demands (or supply) necessary to achieve habitat goals. Conduct a workshop with the Planning Unit to discuss and agree upon the range of goals, which could be considered, and probable implementation schedules.

#### **Subtask 10.3: Future water needed for water quality**

Activities: Based on the water quality assessments, estimate the water supplies necessary to meet water quality goals with and without BMPs in place for surface water discharges. Without BMPs water quality improvements will be based on dilution with new supplies only. Conduct a workshop with the Planning Unit to discuss the level of BMP implementation and potential BMP implementation schedules.

Deliverables: The following products will be provided to the Planning Unit following Task 10:

- Demand forecast summaries for each subbasin for planning years 2005, 2010, 2015, 2020 and 2050 or “maximum build-out”.
- Technical memorandum comparing the demand projections against available developable supply for WRIA 12 including basin model graphics. One draft and one final version will be prepared.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Provide population and employment forecasts, growth rate variability for WRIA by planning year for different scenarios.
- Identify land use development patterns.
- Attend, participate and provide input and direction during workshops regarding development of alternative demand scenarios.
- Review, comment and approve technical memorandum.

### **Task 11: Report**

Objective: Summarize the WRIA 12 watershed assessment findings in a single document.

Activities: The culmination of the Technical Assessment project will be a comprehensive project report to the Planning Unit. The final report will include the bibliography/GIS deliverables with documentation, summaries of electronic databases generated, and the basin model scenarios for present and future conditions to comply with the requirements of RCW 90.82. The report will contain a suggested scope of work for conducting the Phase 3 Watershed Plan, incorporate all

technical memoranda prepared during the watershed assessment, and the Clover Chambers Creek basin model. A draft report will be prepared for Planning Unit review and a final draft prepared within 4 weeks of receiving the Planning Unit's comments. The initial draft will be distributed in hard copy only with the final copy being distributed in hardcopy, CD, and electronic web-based form. The Consultant will prepare and conduct a workshop for presentation of the draft report and findings prior to Planning Unit review.

Deliverables: The following products will be provided to the Planning Unit following Task 11:

- A reproducible draft copy of the final WRIA 12 Watershed Assessment report for distribution to the Planning Unit.
- A reproducible final draft of the WRIA 12 Watershed Assessment report incorporating Planning Unit comments.
- A CD version of the final draft.
- A web-ready final draft of the WRIA 12 Watershed Assessment report incorporating Planning Unit comments.

Planning Unit Responsibilities: The planning unit will conduct the following activities:

- Attend, participate and provide input and direction during workshops.
- Submit comments from the review of the draft copy of the report.
- Approve final report.
- Post electronic WRIA Watershed Assessment report on the project web site